

We claim:

1. A fluid actuator for regulating fluid flow, the actuator comprising:
  - a main fluid passageway, defined at least in part by a diaphragm having an inside facing inwardly relative to the main passageway, and an outside facing outwardly relative to the main passageway;
  - a main valve disposed to inhibit fluid flow through the main fluid passageway, the main valve being connected to the diaphragm by a rigid member, and the main valve being disposed to open outwardly from the main fluid passageway, such that pressure within the main passageway tends to hold the main valve closed, and pressure on the outside of the diaphragm tends to push open the main valve;
  - a chamber defined in part by the outside of the diaphragm; and
  - a pilot valve, comprising:
    - an input passageway that diverts a portion of the fluid flow from the main fluid passageway;
    - an output passageway that directs the diverted portion of the fluid flow to the chamber;
  - a rotatable shaft disposed between the input and output passageways, the rotatable shaft having a slot therein that gives the rotatable shaft a varied cross-section as a function of its angular position, the slot being disposed to permit fluid to flow between the input passageway and the output passageway except when the rotatable shaft is in a closed position;

- a permanent magnet affixed to the rotatable shaft;
    - an electromagnet disposed to generate first magnetic field that, via the permanent magnet, drives the rotatable shaft away from the closed position;
    - a control element that places a dithered PWM current on the electromagnet, such that the length of the duty cycle controls the strength of the first magnetic field;
    - a second magnet disposed to generate a second magnetic field that drives the rotatable shaft away from the closed position.
- 2. The fluid actuator of Claim 1, wherein the second magnet is a failsafe magnet that returns the rotatable shaft to the closed position when power is lost.
- 3. The fluid actuator of Claim 1, wherein the second magnet is a second permanent magnet.
- 4. The fluid actuator of Claim 1, wherein the second magnet is a second electromagnet that receives current during the off-duty portion of the dithered PWM current.
- 5. The fluid actuator of Claim 1, wherein the second magnet comprises the electromagnet receiving a current with an amplitude opposite the amplitude of the PWM current during the off-duty portions of the PWM current.

6. A pilot valve for a proportional control valve mechanism, the pilot valve comprising:

an input passageway that receives a fluid;

an output passageway that outputs the fluid;

a rotatable shaft disposed between the input and output passageways, the rotatable shaft having a slot therein that gives the rotatable shaft a varied cross-section as a function of its angular position, the slot being disposed to permit fluid to flow between the input passageway and the output passageway except when the rotatable shaft is in a closed position;

a permanent magnet affixed to the rotatable shaft;

an electromagnet disposed to generate first magnetic field that, via the permanent magnet, drives the rotatable shaft away from the closed position;

a control element that places a dithered PWM current on the electromagnet, such that the length of the duty cycle controls the strength of the first magnetic field;

a second magnet disposed to generate a second magnetic field that drives the rotatable shaft away from the closed position.

7. The fluid actuator of Claim 6, wherein the second magnet is a failsafe magnet that returns the rotatable shaft to the closed position when power is lost.

8. The fluid actuator of Claim 6, wherein the second magnet is a second permanent magnet.

9. The fluid actuator of Claim 6, wherein the second magnet is a second electromagnet that receives current during the off-duty portion of the dithered PWM current.

10. The fluid actuator of Claim 6, wherein the second magnet comprises the electromagnet receiving a current with an amplitude opposite the amplitude of the PWM current during the off-duty portions of the PWM current.

11. A hands-free water faucet, comprising:

at least one main water passageway, defined at least in part by a diaphragm having an inside facing inwardly relative to the main passageway, and an outside facing outwardly relative to the main passageway;

a flap valve disposed to inhibit fluid flow through the at least one main water passageway, the flap valve being connected to the diaphragm by a rigid member, and the flap valve being disposed to open outwardly from the main fluid passageway, such that pressure within the main passageway tends to hold the flap valve closed, and pressure on the outside of the diaphragm tends to push open the flap valve;

a chamber defined in part by the outside of the diaphragm; and

a pilot valve, comprising:

an input passageway that diverts a portion of water flow from the at least one main water passageway;

an output passageway that directs the diverted portion of the water flow to the chamber;

a rotatable shaft disposed between the input and output passageways, the rotatable shaft having a slot therein that gives the rotatable shaft a varied cross-section as a function of its angular position, the slot being disposed to permit water to flow between the input passageway and the output passageway except when the rotatable shaft is in a closed position;

a permanent magnet affixed to the rotatable shaft;

an electromagnet disposed to generate first magnetic field that, via the permanent magnet, drives the rotatable shaft away from the closed position;

a control element that places a current signal on the electromagnet that controls the strength of the first magnetic field;

a second magnet disposed to generate a second magnetic field that drives the rotatable shaft away from the closed position.

12. The fluid actuator of Claim 11, wherein the second magnet is a failsafe magnet that returns the rotatable shaft to the closed position when power is lost.

13. The fluid actuator of Claim 11, wherein the second magnet is a second permanent magnet.

14. The fluid actuator of Claim 11, wherein the second magnet is a second electromagnet that receives current during the off-duty portion of the dithered PWM current.
15. The fluid actuator of Claim 11, wherein the failsafe magnet comprises the electromagnet receiving a current with an amplitude opposite the amplitude of the PWM current during the off-duty portions of the PWM current.